

General

Guideline Title

ACR Appropriateness Criteria® chronic ankle pain.

Bibliographic Source(s)

Chang EY, Tadros AS, Amini B, Bell AM, Bernard SA, Fox MG, Gorbachova T, Ha AS, Lee KS, Metter DF, Mooar PA, Shah NA, Singer AD, Smith SE, Taljanovic MS, Thiele R, Kransdorf MJ, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® chronic ankle pain. Reston (VA): American College of Radiology (ACR); 2017. 17 p. [96 references]

Guideline Status

This is the current release of the guideline.

Luchs JS, Flug JA, Weissman BN, Kransdorf MJ, Appel M, Arnold E, Bancroft LW, Bruno MA, Fries IB, Hayes CW, Jacobson JA, Morrison WB, Mosher TJ, Murphey MD, Palestro CJ, Roberts CC, Rubin DA, Tuite MJ, Ward RJ, Zoga AC, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® chronic ankle pain. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 9 p. [59 references].

This guideline meets NGC's 2013 (revised) inclusion criteria.

NEATS Assessment

National Guideline Clearinghouse (NGC) has assessed this guideline's adherence to standards of trustworthiness, derived from the Institute of Medicine's report [Clinical Practice Guidelines We Can Trust](#).

■■■■■= Poor ■■■■■= Fair ■■■■■= Good ■■■■■= Very Good ■■■■■= Excellent

Assessment	Standard of Trustworthiness
YES	Disclosure of Guideline Funding Source
■■■■■	Disclosure and Management of Financial Conflict of Interests

	Guideline Development Group Composition
YES	Multidisciplinary Group
YES	Methodologist Involvement
<div><div></div><div></div><div></div><div></div></div>	Patient and Public Perspectives
	Use of a Systematic Review of Evidence
<div><div></div><div></div><div></div><div></div><div></div></div>	Search Strategy
<div><div></div><div></div><div></div><div></div><div></div></div>	Study Selection
<div><div></div><div></div><div></div><div></div><div></div></div>	Synthesis of Evidence
	Evidence Foundations for and Rating Strength of Recommendations
<div><div></div><div></div><div></div><div></div><div></div></div>	Grading the Quality or Strength of Evidence
<div><div></div><div></div><div></div><div></div><div></div></div>	Benefits and Harms of Recommendations
<div><div></div><div></div><div></div><div></div><div></div></div>	Evidence Summary Supporting Recommendations
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Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Chronic Ankle Pain

Variant 1: Chronic ankle pain. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
X-ray ankle	Usually Appropriate	☼
Tc-99m bone scan ankle	Usually Not Appropriate	☼☼☼
US ankle	Usually Not Appropriate	0
CT ankle without IV contrast	Usually Not Appropriate	☼
CT ankle with IV contrast	Usually Not Appropriate	☼
CT ankle without and with IV contrast	Usually Not Appropriate	☼
MRI ankle without IV contrast	Usually Not Appropriate	0

MRI ankle without and with IV contrast	Usually Not Appropriate	0
Procedure	Appropriateness Category	Relative Radiation Level

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Chronic ankle pain. Multiple sites of degenerative joint disease in the hindfoot detected by ankle radiographs. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
Image-guided anesthetic injection hindfoot/ankle	May Be Appropriate	Varies
MRI hindfoot/ankle without IV contrast	May Be Appropriate	0
CT hindfoot/ankle without IV contrast	May Be Appropriate	☢
CT hindfoot/ankle with IV contrast	Usually Not Appropriate	☢
CT hindfoot/ankle without and with IV contrast	Usually Not Appropriate	☢
MRI hindfoot/ankle without and with IV contrast	Usually Not Appropriate	0
Tc-99m bone scan hindfoot/ankle	Usually Not Appropriate	☢☢☢
US hindfoot/ankle	Usually Not Appropriate	0
CT arthrography hindfoot/ankle	Usually Not Appropriate	☢
MR arthrography hindfoot/ankle	Usually Not Appropriate	0
X-ray arthrography hindfoot/ankle	Usually Not Appropriate	☢

Variant 3: Chronic ankle pain. Ankle radiographs normal, suspected osteochondral lesion. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
MRI ankle without IV contrast	Usually Appropriate	0
CT arthrography ankle	May Be Appropriate	☢
MR arthrography ankle	May Be Appropriate	0
Tc-99m bone scan with SPECT/CT ankle	May Be Appropriate (Disagreement)	☢☢☢
CT ankle without IV contrast	May Be Appropriate	☢
MRI ankle without and with IV contrast	Usually Not Appropriate	0
CT ankle with IV contrast	Usually Not Appropriate	☢
CT ankle without and with IV contrast	Usually Not Appropriate	☢
X-ray ankle stress views	Usually Not Appropriate	☢
US ankle	Usually Not Appropriate	0
X-ray arthrography ankle	Usually Not Appropriate	☢
Image-guided anesthetic injection ankle	Usually Not Appropriate	Varies

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Chronic ankle pain. Ankle radiographs normal or nonspecific, suspected tendon abnormality. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
MRI ankle without IV contrast	Usually Appropriate	0

Procedure	Appropriateness Category	Relative Radiation Level
US ankle	Usually Appropriate	0
US-guided anesthetic injection ankle tendon sheath	May Be Appropriate	
MRI ankle without and with IV contrast	Usually Not Appropriate	0
X-ray ankle stress views	Usually Not Appropriate	☢
Tc-99m bone scan ankle	Usually Not Appropriate	☢ ☢ ☢
CT ankle without IV contrast	Usually Not Appropriate	☢
CT ankle with IV contrast	Usually Not Appropriate	☢
CT ankle without and with IV contrast	Usually Not Appropriate	☢
CT arthrography ankle	Usually Not Appropriate	☢
MR arthrography ankle	Usually Not Appropriate	0
X-ray tenography ankle	Usually Not Appropriate	☢
X-ray arthrography ankle	Usually Not Appropriate	☢

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 5: Chronic ankle pain. Ankle radiographs normal or nonspecific, suspected ankle instability. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
MRI ankle without IV contrast	Usually Appropriate	0
MR arthrography ankle	Usually Appropriate	0
US ankle	May Be Appropriate	0
X-ray ankle stress views	May Be Appropriate	☢
CT arthrography ankle	May Be Appropriate	☢
MRI ankle without and with IV contrast	Usually Not Appropriate	0
Tc-99m bone scan ankle	Usually Not Appropriate	☢ ☢ ☢
CT ankle without IV contrast	Usually Not Appropriate	☢
CT ankle with IV contrast	Usually Not Appropriate	☢
CT ankle without and with IV contrast	Usually Not Appropriate	☢
X-ray arthrography ankle	Usually Not Appropriate	☢
Image-guided anesthetic injection ankle	Usually Not Appropriate	Varies

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 6: Chronic ankle pain. Ankle radiographs normal or nonspecific, suspected ankle impingement syndrome. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
MRI ankle without IV contrast	Usually Appropriate	0
MR arthrography ankle	May Be Appropriate	0
CT ankle without IV contrast	May Be Appropriate	☢
CT arthrography ankle	May Be Appropriate	☢
Image-guided anesthetic injection ankle	May Be Appropriate (Disagreement)	Varies
US ankle	May Be Appropriate	0
MRI ankle without and with IV contrast	Usually Not Appropriate	0

Procedure	Appropriateness Category	Relative Radiation Level
Tc-99m 3-phase bone scan with SPECT/CT ankle	Usually Not Appropriate	⚠⚠⚠
CT ankle with IV contrast	Usually Not Appropriate	⚠
CT ankle without and with IV contrast	Usually Not Appropriate	⚠
X-ray ankle stress views	Usually Not Appropriate	⚠
X-ray arthrography ankle	Usually Not Appropriate	⚠

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 7: Chronic ankle pain. Ankle radiographs normal, pain of uncertain etiology. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
MRI ankle without IV contrast	Usually Appropriate	O
CT ankle without IV contrast	May Be Appropriate	⚠
Tc-99m bone scan with SPECT/CT ankle	May Be Appropriate (Disagreement)	⚠⚠⚠
Image-guided anesthetic injection ankle	May Be Appropriate	Varies
US ankle	May Be Appropriate	O
CT ankle with IV contrast	Usually Not Appropriate	⚠
CT ankle without and with IV contrast	Usually Not Appropriate	⚠
CT arthrography ankle	Usually Not Appropriate	⚠
MR arthrography ankle	Usually Not Appropriate	O
MRI ankle without and with IV contrast	Usually Not Appropriate	O
X-ray ankle stress views	Usually Not Appropriate	⚠
X-ray arthrography ankle	Usually Not Appropriate	⚠

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

Ankle pain is considered chronic when symptoms persist >6 weeks. Chronic ankle pain can be caused by a variety of osseous or soft-tissue abnormalities, either alone or in combination. For assessing chronic ankle pain, there are multiple imaging options, including radiography, stress radiography, computed tomography (CT) radionuclide bone scanning, ultrasound (US), magnetic resonance imaging (MRI), and various injection procedures. Injection procedures include arthrography, CT arthrography, MR arthrography, and diagnostic injection with anesthetic agents. Although there are numerous causes for chronic ankle pain, common etiologies include osteoarthritis, osteochondral injury, tendon abnormalities, ligament abnormalities and instability, and impingement.

Overview of Imaging Modalities

Radiography

Radiographs can provide information about the osseous and soft-tissue structures about the ankle. Routine radiographs of the ankle typically include anteroposterior, lateral, and mortise views, the latter obtained by internally rotating the foot 15 to 20 degrees. Stress radiographs can be used to assess ankle instability; however, some have questioned their accuracy.

CT

CT is not routinely used as a first-line imaging tool in chronic ankle pain, but it is more sensitive than radiographs, particularly for osseous abnormalities. CT arthrography may be more accurate than MR arthrography for the identification of osteochondral abnormalities.

Bone Scan

Conventional planar bone scintigraphy can assess osseous pathology. More recently, single-photon emission computed tomography (SPECT) combined with CT has been shown to provide additional information compared with clinical diagnosis and conventional bone scintigraphy for the evaluation of impingement syndromes and soft-tissue pathology. In addition, SPECT/CT abnormalities have been shown to significantly correlate with pain in osteochondral lesions.

US

US can be used to evaluate for soft-tissue abnormalities, including tendon and ligament tears. In inflammatory arthritis, it can help in the assessment of disease activity and severity as well as detect subclinical pathology in early disease or after treatment. US is ideal for dynamic assessment of peroneal tendon instability and can be used to guide interventions. Compared with some other modalities, US is less prone to artifacts, such as susceptibility, motion, magic angle, and streak artifact, but dynamic assessment may be limited in cases of pain.

MRI

MRI is the imaging test that globally evaluates all anatomic structures, including ligaments, tendons, cartilage, and bone. Most studies have shown that MRI is highly accurate for evaluation of ligament, tendon, and osteochondral abnormalities, although one study found statistically significant lower sensitivity for these abnormalities on MRI as compared to arthroscopy. MRI can identify synovitis and impingement lesions, which can contribute to patient symptoms.

Discussion of Procedures by Variant

Variant 1: Chronic Ankle Pain. Initial Imaging

Radiography

Radiography should be considered as the initial imaging study. Radiographs may reveal osteoarthritis, calcified or ossified intra-articular bodies, osteochondral abnormalities, stress fractures, or evidence of prior trauma. Ankle effusions may also be identified in the anterior ankle joint recess by radiography with 53% to 74% accuracy. They are often associated with ligamentous injury or fracture. The presence of ossific fragments can indicate ligamentous injury or retinaculum avulsion, whereas periostitis can occur adjacent to tenosynovitis. Radiographs can also identify synovial osteochondromatosis and erosions from chronic synovitis.

CT

CT is not routinely used as the first study for the evaluation of chronic ankle pain.

MRI

MRI is not routinely used as the first study for the evaluation of chronic ankle pain.

US

US is not routinely used as the first study for the evaluation of chronic ankle pain.

Bone Scan

Bone scan is not routinely used as the first study for the evaluation of chronic ankle pain.

Variant 2: Chronic Ankle Pain. Multiple Sites of Degenerative Joint Disease in the Hindfoot Detected by Ankle Radiographs. Next Study

When multiple sites of osteoarthritis are present, it may be important to determine which joint is the cause of symptoms.

Image-guided Anesthetic Injection

Several reports have indicated the effectiveness of fluoroscopic, CT, or US-guided anesthetic with or without corticosteroid injection of joints to identify a source of pain, which aids in surgical planning.

MRI

When degenerative changes of the ankle joint are diagnosed based on radiographs, MRI may be considered as the next best examination to evaluate cartilage integrity, bone marrow, and associated soft tissues, such as ligaments and tendons, if these injuries are clinically suspected.

CT

CT without contrast may be helpful to visualize subchondral cysts.

US

US is not routinely used for the evaluation of degenerative joint disease.

Bone Scan

Bone scan is not routinely used for the evaluation of degenerative joint disease.

Arthrography

Arthrography is not routinely used for the evaluation of degenerative joint disease.

MR Arthrography

MR arthrography is not routinely used for the evaluation of degenerative joint disease.

CT Arthrography

CT arthrography is not routinely used for the evaluation of degenerative joint disease.

Variant 3: Chronic Ankle Pain. Ankle Radiographs Normal, Suspected Osteochondral Lesion. Next Study

Osteochondral injuries may involve the talar dome and, less commonly, the tibial plafond and tarsal navicular bone. If this injury is associated with fracture, osseous cyst, or osteochondral defect, radiography may show the abnormality; however, radiography often fails to show the extent of the osteochondral injury and will be initially negative if the injury is limited to the articular hyaline cartilage. One multimodality study showed that 41% of osteochondral abnormalities of the ankle were missed on radiography.

MRI

In one multimodality study, MRI performed similarly to arthroscopy for the evaluation of osteochondral abnormalities of the ankle. Although MRI had the highest sensitivity (96%), it was less specific than CT. MRI is effective in determining osteochondral injury instability (sensitivity 97%), most commonly appearing as a high signal line deep to the osteochondral lesion on T2-weighted images or less commonly as a focal defect, an articular fracture, or an adjacent cyst. MRI has also been used to stage these lesions preoperatively with an accuracy of 81% and to assess osteochondral abnormalities after cartilage repair. Although MRI may be less reliable than CT arthrography for talar cartilaginous lesions (accuracy between 76% and 88%), high-resolution MRI using a microscopy coil (e.g., a 4-cm receive-only surface coil) can assist in detecting small, clinically relevant features of talar osteochondral lesions that may be missed on standard MRI, including osteochondral junction separation due to focal collapse of the subchondral bone, reparative cartilage hypertrophy, and bone separation in the absence of cartilage fracture.

CT Arthrography

The introduction of contrast into the ankle joint prior to CT will outline a cartilage surface defect, assisting in lesion detection and assessment for instability. One study comparing CT arthrography and MR arthrography for talar cartilaginous lesions found an accuracy between 76% and 88% using MR arthrography compared to 90% to 92% for CT arthrography, suggesting that CT arthrography may be more reliable.

MR Arthrography

The introduction of contrast into the ankle joint prior to MRI will outline a cartilage surface defect, assisting in lesion detection and assessment for instability. One study comparing CT arthrography and MR arthrography for talar cartilaginous lesions found an accuracy between 76% and 88% using MR arthrography compared to 90% to 92% for CT arthrography, suggesting that CT arthrography may be more reliable.

CT

In one multimodality study, CT (noncontrast, multidetector with multiplanar reformatted images) performed similarly to arthroscopy for the evaluation of osteochondral abnormalities of the ankle. However, CT was more specific (99%) but less sensitive than MRI.

Bone Scan with SPECT/CT

When osteochondral injuries are associated with fracture, osseous cyst, or osteochondral defect, bone scans may show the abnormality. One study evaluating the role of SPECT/CT in assessing osteochondral defects in the ankle found that this study affected the surgeon's ultimate decision regarding treatment in 48% to 52% of cases, as it allowed for improved evaluation of the subchondral bone and subchondral bone plate. SPECT/CT abnormalities have also been shown to significantly correlate with pain in the setting of osteochondral lesions and to precisely localize the painful regions in the setting of multiple lesions.

US

US is not routinely used for the evaluation of osteochondral lesions in the ankle.

Radiography

Stress views are not routinely used for the evaluation of osteochondral lesions in the ankle.

Arthrography

Arthrography is not routinely used for the evaluation of osteochondral lesions in the ankle.

Image-guided Anesthetic Injection

Image-guided anesthetic injections may be helpful to assess whether an osteochondral lesion in the ankle is the source of the patient's pain.

Variant 4: Chronic Ankle Pain. Ankle Radiographs Normal or Nonspecific, Suspected Tendon Abnormality.
Next Study

Possible tendon abnormalities include tenosynovitis, tendinopathy, tendon tear (partial or complete), and tendon subluxation or dislocation. Both MRI and US can effectively demonstrate ankle tendon abnormalities, although US results are more dependent on operator skill and expertise. For the assessment, it is assumed the procedure is performed and interpreted by an expert.

US

US can be used to evaluate for soft-tissue abnormalities, including tendon and ligament tears. It has been shown to produce similar results as MRI in diagnosing ankle tendon tears, although US results are

more dependent on operator skill and expertise. In this case, it is assumed that the procedure is performed and interpreted by an expert. One study showed that it had a sensitivity of 100% and an accuracy of 93% compared to surgical findings. With regard to the tibialis posterior tendon, one study evaluating tendon pathology showed that US was slightly less sensitive than MRI; however, this difference did not significantly affect clinical management. One study using US showed 100% sensitivity and 90% accuracy in diagnosing peroneal tendon tears; suggesting that US may be more useful than MRI. With regard to chronic Achilles tendinopathy, US detected 21 of 26 cases of tendinosis and partial rupture, and another study showed that US can differentiate full-thickness from partial-thickness Achilles tears with 92% accuracy. In addition to the diagnostic capabilities of US, when a tendon abnormality is detected, it can be used to guide interventions such as concurrent performance of US-guided intrasheath anesthetic injections. It can also be used for direct intratendinous biologic injection and dry needling.

One significant advantage of US is in the dynamic assessment for tendon subluxation (including intrasheath subluxation) and dislocation, with a reported positive predictive value of 100% compared to surgical findings.

US-guided sheath injections are more accurate than palpation guided and allow for precise positioning of the needle tip in the sheath rather than the tendon substance because a large volume intratendinous injection of corticosteroids or local anesthetic can result in a split tear.

US can detect intratendinous tophi in gout, enthesitis of the Achilles tendon or plantar fascia in spondyloarthritis, and tenosynovitis in spondyloarthritis and rheumatoid arthritis.

MRI

It is generally accepted that MRI can achieve high sensitivities (>90%) in diagnosing ankle tendon tears. Regarding tibialis posterior tendon, MRI is more sensitive than US; however, this difference did not significantly affect clinical management. With regard to peroneal tendinopathy and tendon tear, one study found the sensitivities and specificities of MRI to be 83.9% and 74.5%, respectively, for tendinopathy and 54.5% and 88.7%, respectively, for tendon tears. With regard to chronic Achilles tendinopathy, MRI detected 26 of 27 cases of tendinosis and partial rupture. MRI reported a 66% accuracy rate for assessment for tendon subluxation and dislocation. MRI evidence of peroneal tendon pathology should be treated with caution because up to 34% of asymptomatic patients may have a tear of the peroneus brevis tendon. One study showed that MRI evidence of peroneal tendon pathology had a 48% positive predictive value for clinical findings, highlighting the importance of clinical examination.

Image-guided Anesthetic Injection

In addition to the diagnostic capabilities of US, when a tendon abnormality is detected, a fluoroscopic or US-guided intrasheath anesthetic injection can be concurrently performed.

Tenography

Diagnostic and therapeutic ankle tenography can also be considered for evaluation, with one study reporting that 47% of patients had prolonged relief of symptoms.

CT

CT is not routinely used for the evaluation of suspected tendon abnormality.

Bone Scan

Bone scan is not routinely used for the evaluation of suspected tendon abnormality.

CT Arthrography

CT arthrography is not routinely used for the evaluation of suspected tendon abnormality.

MR Arthrography

MR arthrography is not routinely used for the evaluation of suspected tendon abnormality.

Arthrography

Arthrography is not routinely used for the evaluation of suspected tendon abnormality.

Radiography

Stress views are not routinely used for the evaluation of suspected tendon abnormality.

Variant 5: Chronic Ankle Pain. Ankle Radiographs Normal or Nonspecific, Suspected Ankle Instability. Next Study

In the absence of findings on routine radiography, imaging options to evaluate ligamentous integrity include stress radiography, MRI, MR arthrography, CT arthrography, and US.

MRI

One study evaluating anterior talofibular ligament injury demonstrated a diagnostic accuracy of 97% for MRI when compared to arthroscopic findings. Additionally, MRI identified the exact location of the injury in 93% of the cases. Comparing MRI with arthroscopy, studies have shown a range of accuracies of chronic lateral ligament tearing (either partial or complete), ranging from 77% to 92% for the anterior talofibular ligament and 88% to 92% for the calcaneofibular ligament. For the evaluation of deep deltoid ligament tears, MRI is both sensitive and specific compared with arthroscopy, with reported values of 96% and 98%, respectively.

With regard to tears of the tibiofibular ligaments of the tibiofibular syndesmosis, MRI has a reported accuracy of 100%. Additionally, MRI can also demonstrate interosseous membrane tears. MRI offers the advantage of evaluating for injuries associated with or mimicking lateral instability that may not be diagnosed on stress radiography such as tenosynovitis, tendon injury, and osteochondral lesions. MRI may also be used to evaluate the ankle after lateral ligament reconstruction.

MR Arthrography

MR arthrography can be helpful for the assessment of chronic ankle instability due to lateral collateral ligament injuries.

US

One study evaluating anterior talofibular ligament injury demonstrated a diagnostic accuracy of 91% for US when compared to arthroscopic findings. Additionally, US identified the exact location of the injury in 63% of cases. Another study comparing US and CT arthrography for the diagnosis of anterior talofibular ligament injury showed an accuracy of 61% using US and 71% for CT arthrography. US also has the dynamic capability of stressing the ligament and looking for laxity or frank separation of the injured ligament.

With regard to interosseous membrane tears, US has a proven sensitivity of 89% and specificity of 94.5% in diagnosing interosseous membrane tears shown at surgery.

Radiography

Stress radiographs can be used to assess ankle instability; however, some have questioned their accuracy. One study evaluating anterior talofibular ligament injury demonstrated a diagnostic accuracy of 67% for stress radiography. One study compared stress radiography to arthroscopic findings and found the former has an accuracy of 67% for evaluating anterior talofibular ligament injuries. Subtalar stress radiography using forced dorsiflexion and supination or talar rotation can be used to evaluate subtalar laxity.

CT Arthrography

CT arthrography showed an accuracy of 71% for diagnosing anterior talofibular ligament injury.

CT

CT is not routinely used for the evaluation of ligamentous integrity.

Arthrography

Arthrography is not routinely used for the evaluation of ligamentous integrity.

Image-guided Anesthetic Injection

Image-guided anesthetic injection is not routinely used for the evaluation of ligamentous integrity.

Bone Scan

Bone scan is not routinely used for the evaluation of ligamentous integrity.

Variant 6: Chronic Ankle Pain. Ankle Radiographs Normal or Nonspecific, Suspected Ankle Impingement Syndrome. Next Study

Imaging can also be used to diagnose ankle impingement syndromes, which can occur in the anterolateral, anterior, anteromedial, posteromedial, and posterior aspects of the ankle joint.

MR Arthrography

MR arthrography has been found to be an accurate method for assessing both anterolateral and anteromedial impingement with the advantage of joint capsule distention by intra-articular contrast injection.

US

One study involving anterolateral ankle impingement compared US to arthroscopic findings. The study found US had a sensitivity and specificity of 77% and 57%, respectively. US also showed abnormal soft tissues in anterolateral impingement, with a reported accuracy of 100% in one study.

MRI

Studies on the accuracy of MRI in diagnosing anterolateral impingement syndrome have drawn varying conclusions, which may be related to varying MRI magnet strengths and inconsistent protocols. Comparing MRI with surgical findings, studies have shown sensitivities between 75% and 83% and specificity between 75% and 100% for the diagnosis of anterolateral impingement.

One study found that, when compared with arthroscopy, fat-suppressed, IV contrast-enhanced, 3-D gradient-recalled echo imaging was sensitive for the evaluation of synovitis of the ankle associated with trauma (92%), whereas it was specific for soft-tissue impingement evaluation (97%) when the ankle was divided into four compartments: the anterolateral gutter, anteromedial gutter, anterior recess, and posterior recess.

MRI is useful in confirming the diagnosis, evaluating patients with an uncertain clinical diagnosis, and planning surgery. Additionally, it can help exclude other pathologic entities that may mimic or coexist with impingement syndromes. However, MRI features supportive of impingement may be present in asymptomatic individuals, and an accurate diagnosis requires careful correlation of imaging features findings with clinical findings. There are only limited reports on the use of MRI for the other forms of ankle impingement syndrome, so its accuracy in these conditions is not well established.

CT Arthrography

One study involving anterolateral ankle impingement compared CT arthrography to arthroscopic findings. The study found that CT arthrography had a sensitivity and specificity of 97% and 71%, respectively.

Image-guided Anesthetic Injection

Fluoroscopic or US-guided injections have been shown as an effective treatment for some ankle impingement syndromes.

Bone Scan with SPECT/CT

Recently, SPECT combined with CT has been shown to provide additional information compared with clinical diagnosis and conventional bone scintigraphy for the evaluation of impingement syndromes and soft-tissue pathology. One study found that SPECT/CT provided information not suspected on clinical diagnosis in 56% of cases with impingement syndromes or soft-tissue pathology.

CT

CT may be useful for depiction of osseous causes of impingement, such as chronic abnormalities between the talus and an os trigonum or fractures of the lateral tubercle of the talus or os trigonum.

Arthrography

Arthrography is not routinely used for the evaluation of ankle impingement syndromes.

Radiography

Stress views are not routinely used for the evaluation of ankle impingement syndromes.

Variant 7: Chronic Ankle Pain. Ankle Radiographs Normal, Pain of Uncertain Etiology. Next Study

When chronic ankle pain is of unclear etiology, normal ankle radiographs can be followed by other imaging tests, primarily directed by clinical findings.

MRI

If the patient has a focal soft-tissue abnormality, MRI can be considered. Peripheral nerve-related symptoms can be evaluated with US or MRI; however, US has the benefit of higher resolution. If symptoms are believed to originate from osseous structures, MRI can be considered if there is concern for an initially missed fracture. MRI is effective in detecting osseous stress injuries. Overall, MRI is the imaging test that globally evaluates all anatomic structures, including bone marrow.

US

US is best used as a focal examination and should not be used for comprehensive evaluation of the ankle when no particular pathology is suspected. If the patient has a focal soft-tissue abnormality, US can be considered. Peripheral nerve-related symptoms can be evaluated with US or MRI; however, US has the benefit of higher resolution. US with dynamic evaluation should be considered when symptoms are only present during specific movements or positions.

CT

If symptoms are believed to originate from osseous structures, CT can be considered if there is concern for an initially missed fracture. CT has been shown to be superior to radiography for fracture detection.

Bone Scan with SPECT/CT

SPECT/CT is an emerging imaging modality for evaluation of ankle pathology and can detect osteochondral lesions, osteoarthritis, tarsal coalition, occult fractures, or painful accessory bones.

Arthrography

Arthrography is not routinely used for the evaluation of pain of unknown etiology in the ankle.

CT Arthrography

CT arthrography is not routinely used for the evaluation of pain of unknown etiology in the ankle.

MR Arthrography

MR arthrography is not routinely used for the evaluation of pain of unknown etiology in the ankle.

Image-guided Anesthetic Injection

US-guided nerve blocks have been reported to be helpful for diagnostic purposes and to plan for surgical or procedural intervention.

Radiography

Stress views are not routinely used for the evaluation of pain of unknown etiology in the ankle.

See the original guideline document for other causes of chronic ankle pain, including tarsal tunnel syndrome, suspected stress fracture, tarsal coalition, suspected tumor, and inflammatory arthritis or crystal deposition.

Summary of Recommendations

Radiograph of the ankle is the most appropriate initial imaging study.

Image-guided anesthetic injection hindfoot/ankle, MRI hindfoot/ankle without IV contrast, or CT hindfoot/ankle without IV contrast may be appropriate as the next study for degenerative joint disease in the hindfoot detected by ankle radiographs.

MRI ankle without IV contrast should be the next imaging study when ankle radiographs are normal for suspected osteochondral lesion.

Either MRI ankle without IV contrast or US ankle should be ordered when tendon abnormality is suspected and ankle radiographs are normal.

Either MRI ankle without IV contrast or MR arthrography of the ankle should be ordered when ankle instability is suspected and ankle radiographs are normal.

MRI ankle without IV contrast should be ordered when ankle impingement syndrome is suspected and ankle radiographs are normal.

MRI ankle without IV contrast should be ordered as the next study after radiographs when there is pain of uncertain etiology and ankle radiographs are normal.

Abbreviations

CT, computed tomography

IV, intravenous

MR, magnetic resonance

MRI, magnetic resonance imaging

SPECT, single-photon emission computed tomography

Tc-99m, technetium 99 metastable

US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
0	0 mSv	0 mSv
☼	<0.1 mSv	<0.03 mSv
☼ ☼	0.1-1 mSv	0.03-0.3 mSv
☼ ☼ ☼	1-10 mSv	0.3-3 mSv
☼ ☼ ☼ ☼	10-30 mSv	3-10 mSv
☼ ☼ ☼ ☼ ☼	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Chronic ankle pain

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Family Practice

Internal Medicine

Nuclear Medicine

Orthopedic Surgery

Podiatry

Radiology

Rheumatology

Intended Users

Advanced Practice Nurses

Health Care Providers

Hospitals

Managed Care Organizations

Physician Assistants

Physicians

Podiatrists

Students

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of imaging procedures for patients with chronic ankle pain

Target Population

Patients with chronic ankle pain

Interventions and Practices Considered

1. Computed tomography (CT)
 - Ankle without intravenous (IV) contrast
 - Ankle with IV contrast
 - Ankle without and with IV contrast
 - Hindfoot/ankle without IV contrast
 - Hindfoot/ankle with IV contrast
 - Hindfoot/ankle without and with IV contrast
2. CT arthrography
 - Hindfoot/ankle
 - Ankle
3. Image-guided anesthetic injection
 - Hindfoot/ankle
 - Ankle
4. Magnetic resonance (MR) arthrography
 - Hindfoot/ankle
 - Ankle
5. Magnetic resonance imaging (MRI)
 - Ankle without IV contrast
 - Ankle without and with IV contrast
 - Hindfoot/ankle without IV contrast
 - Hindfoot/ankle without and with IV contrast
6. Technetium (Tc-99m) bone scan
 - Ankle
 - Hindfoot/ankle
 - With single-photon emission computed tomography (SPECT)/CT, ankle
 - 3-phase with SPECT/CT, ankle
7. Ultrasound (US) ankle
8. US-guided anesthetic injection ankle tendon
9. X-ray
 - Ankle
 - Arthrography hindfoot/ankle
 - Arthrography ankle
 - Ankle stress views
 - Tenography ankle

Major Outcomes Considered

- Utility of imaging procedures in assessment and diagnosis of chronic ankle pain
- Sensitivity and specificity of imaging procedures in assessment and diagnosis of chronic ankle pain

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Summary

Of the 59 citations in the original bibliography, 50 were retained in the final document.

A literature search was conducted in April 2015, June 2017, and July 2015 to identify additional evidence published since the *ACR Appropriateness Criteria® Chronic Ankle Pain* topic was finalized. Using the search strategies described in the literature search companion (see the "Availability of Companion Documents" field), 1,359 unique articles were found. Thirty-eight articles were added to the bibliography. The remaining articles were not used due to either poor study design, the articles were not relevant or generalizable to the topic, or the results were unclear or biased.

The author added 3 citations from bibliographies, Web sites, or books that were not found in the literature search.

Five citations are supporting documents that were added by staff.

See also the American College of Radiology (ACR) Appropriateness Criteria® literature search process document (See the "Availability of Companion Documents" field) for further information.

Number of Source Documents

Of the 59 citations in the original bibliography, 50 were retained in the final document. The literature search conducted in April 2015, June 2017, and July 2015 found 38 articles that were added to the bibliography. The author added 3 citations from bibliographies, Web sites, or books that were not found in the literature search. Five citations are supporting documents that were added by staff.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Definitions of Study Quality Categories

Category 1 - The study is well-designed and accounts for common biases.

Category 2 - The study is moderately well-designed and accounts for most common biases.

Category 3 - The study has important study design limitations.

Category 4 - The study or source is not useful as primary evidence. The article may not be a clinical study, the study design is invalid, or conclusions are based on expert consensus.

The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);

Or

The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;

Or

The study is an expert opinion or consensus document.

Category M - Meta-analysis studies are not rated for study quality using the study element method because the method is designed to evaluate individual studies only. An "M" for the study quality will indicate that the study quality has not been evaluated for the meta-analysis study.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author assesses the literature then drafts or revises the narrative summarizing the evidence found in the literature. American College of Radiology (ACR) staff drafts an evidence table based on the analysis of the selected literature. These tables rate the study quality for each article included in the narrative.

The expert panel reviews the narrative, evidence table and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the variant table(s). Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Overview

The purpose of the rating rounds is to systematically and transparently determine the panels' recommendations while mitigating any undue influence of one or more panel members on another individual panel members' interpretation of the evidence. The panel member's rating is determined by reviewing the evidence presented in the Summary of Literature Review and assessing the risks or harms of performing the procedure or treatment balanced with the benefits of performing the procedure or treatment. The individual panel member ratings are used to calculate the median rating, which determines the panel's rating. The assessment of the amount of deviation of individual ratings from the panel rating determines whether there is disagreement among the panel about the rating.

The process used in the rating rounds is a modified Delphi method based on the methodology described in the RAND/UCLA Appropriateness Method User Manual.

The appropriateness is rated on an ordinal scale that uses integers from 1 to 9 grouped into three categories (see the "Rating Scheme for the Strength of the Recommendations" field).

Determining the Panel's Recommendation

Ratings represent an individual's assessment of the risks and benefits of performing a specific procedure for a specific clinical scenario on an ordinal scale. The recommendation is the appropriateness category (i.e., "Usually appropriate", "May be appropriate", or "Usually not

appropriate").

The appropriateness category for a procedure and clinical scenario is determined by the panel's median rating without disagreement (see below for definition of disagreement). The panel's median rating is calculated after each rating round. If there is disagreement after the second rating round, the rating category is "May be appropriate (Disagreement)" with a rating of "5" so users understand the group disagreed on the final recommendation. The actual panel median rating is documented to provide additional context.

Disagreement is defined as excessive dispersion of the individual ratings from the group (in this case, an Appropriateness Criteria [AC] panel) median as determined by comparison of the Interpercentile Range (IPR) and the Interpercentile Range Adjusted for Symmetry (IPRAS). In those instances when the IPR is greater than the IPRAS, there is disagreement. For a complete discussion, please refer to chapter 8 of the RAND/UCLA Appropriateness Method User Manual.

Once the final recommendations have been determined, the panel reviews the document. If two thirds of the panel feel a final recommendation is wrong (e.g., does not accurately reflect the evidence, may negatively impact patient health, has unintended consequences that may harm health care, etc.) and the process must be started again from the beginning.

For additional information on the ratings process see the Rating Round Information Document (see the "Availability of Companion Documents" field).

Additional methodology documents, including a more detailed explanation of the complete topic development process and all ACR AC topics can be found on the [ACR Web site](#) (see also the "Availability of Companion Documents" field.)

Rating Scheme for the Strength of the Recommendations

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current medical evidence literature and the application of the RAND/UCLA appropriateness method and expert panel consensus.

Summary of Evidence

Of the 96 references cited in the *ACR Appropriateness Criteria® Chronic Ankle Pain* document, 5 are categorized as therapeutic references including 1 well-designed study and 3 good-quality studies. Additionally, 91 references are categorized as diagnostic references including 1 well-designed study, 10 good-quality studies, and 41 quality studies that may have design limitations. There are 40 references that may not be useful as primary evidence.

Although there are references that report on studies with design limitations, 15 well-designed or good-quality studies provide good evidence.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- In inflammatory arthritis, ultrasound (US) can help in the assessment of disease activity and severity as well as detect subclinical pathology in early disease or after treatment. US is ideal for dynamic assessment of peroneal tendon instability and can be used to guide interventions.
- One significant advantage of US is in the dynamic assessment for tendon subluxation (including intrasheath subluxation) and dislocation, with a reported positive predictive value of 100% compared to surgical findings.
- Most studies have shown that magnetic resonance imaging (MRI) is highly accurate for evaluation of ligament, tendon, and osteochondral abnormalities.
- MRI is useful in confirming the diagnosis of impingement syndrome, evaluating patients with an uncertain clinical diagnosis, and planning surgery. Additionally, it can help exclude other pathologic entities that may mimic or coexist with impingement syndromes.

Potential Harms

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for

imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

- The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.
- ACR seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through society representation on expert panels. Participation by representatives from collaborating societies on the expert panel does not necessarily imply society endorsement of the final document.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Living with Illness

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Chang EY, Tadros AS, Amini B, Bell AM, Bernard SA, Fox MG, Gorbachova T, Ha AS, Lee KS, Metter DF, Mooar PA, Shah NA, Singer AD, Smith SE, Taljanovic MS, Thiele R, Kransdorf MJ, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® chronic ankle pain. Reston (VA): American College of Radiology (ACR); 2017. 17 p. [96 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2017

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The funding for the process is assumed entirely by the American College of Radiology (ACR). ACR staff support the expert panels through the conduct of literature searches, acquisition of scientific articles, drafting of evidence tables, dissemination of materials for the Delphi process, collation of results, conference calls, document processing, and general assistance to the panelists.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Musculoskeletal Imaging

Composition of Group That Authored the Guideline

Panel Members: Eric Y. Chang, MD (*Principal Author and Panel Chair*); Anthony S. Tadros, MD (*Research Author*); Behrang Amini, MD, PhD; Angela M. Bell, MD; Stephanie A. Bernard, MD; Michael G. Fox, MD, MBA; Tetyana Gorbachova, MD; Alice S. Ha, MD; Kenneth S. Lee, MD, MBA; Darlene F. Metter, MD; Pekka A. Mooar, MD; Nehal A. Shah, MD; Adam D. Singer, MD; Stacy E. Smith, MD; Mihra S. Taljanovic, MD; Ralf Thiele, MD; Mark J. Kransdorf, MD (*Specialty Chair*)

Financial Disclosures/Conflicts of Interest

Disclosing Potential Conflicts of Interest and Management of Conflicts of Interest

An important aspect of committee operations is the disclosure and management of potential conflicts of interest. In 2016, the American College of Radiology (ACR) began an organization-wide review of its conflict of interest (COI) policies. The current ACR COI policy is available on its [Web site](#) . The Appropriateness Criteria (AC) program's COI process varies from the organization's current policy to accommodate the requirements for qualified provider-led entities as designated by the Centers for Medicare and Medicaid Services' Appropriate Use Criteria (AUC) program.

When physicians become participants in the AC program, welcome letters are sent to inform them of their panel roles and responsibilities, including a link to complete the [COI form](#) . The COI form requires disclosure of all potential conflicts of interest. ACR staff oversees the COI evaluation process, coordinating with review panels consisting of ACR staff and members, who determine when there

is a conflict of interest and what action, if any, is appropriate. In addition to making the information publicly available, management may include exclusion from some topic processes, exclusion from a topic, or exclusion from the panel.

Besides potential COI disclosure, AC staff begins every committee call with the conflict of interest disclosure statement on the [Web site](#) reminding members to update their COI forms. If any updates to their COI information have not been submitted, they are instructed not to participate in discussion where an undisclosed conflict may exist.

Finally, all ACR AC are published as part of the Journal of the American College of Radiology (JACR) electronic supplement. Those who participated on the document and are listed as authors must complete the JACR process that includes completing the International Committee of Medical Journal Editors (ICMJE) COI form which is reviewed by the journal's staff/publisher.

Dr. Lee reports grants from National Basketball Association, grants from General Electric, grants from Mitek, and other from Elsevier, outside the submitted work. Dr. Thiele reports personal fees from Amgen, AbbVie, Bioclinica, and Regeneron.

Guideline Status

This is the current release of the guideline.

Luchs JS, Flug JA, Weissman BN, Kransdorf MJ, Appel M, Arnold E, Bancroft LW, Bruno MA, Fries IB, Hayes CW, Jacobson JA, Morrison WB, Mosher TJ, Murphey MD, Palestro CJ, Roberts CC, Rubin DA, Tuite MJ, Ward RJ, Zoga AC, Expert Panel on Musculoskeletal Imaging. ACR Appropriateness Criteria® chronic ankle pain. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 9 p. [59 references].

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Available from the [American College of Radiology \(ACR\) Web site](#) .

Availability of Companion Documents

The following are available:

ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2017.

Available from the [American College of Radiology \(ACR\) Web site](#) .

ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2015 Feb. 1 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria®. Evidence table development. Reston (VA): American College of Radiology; 2015 Nov. 5 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria®. Topic development process. Reston (VA): American College of Radiology; 2015 Nov. 2 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria®. Rating round information. Reston (VA): American College of Radiology; 2017 Sep. 5 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2018. 4 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria®. Manual on contrast media. Reston (VA): American College of Radiology; 2017. 125 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 2017 Mar. 4 p. Available from the [ACR Web site](#) .

ACR Appropriateness Criteria® chronic ankle pain. Evidence table. Reston (VA): American College of Radiology; 2017. 36 p. Available from the [ACR Web site](#) .

Patient Resources

None available

NGC Status

This summary was completed by ECRI on May 6, 2001. The information was verified by the guideline developer as of June 29, 2001. This summary was updated by ECRI on May 22, 2003. The information was verified by the guideline developer on June 23, 2003. This NGC summary was updated by ECRI on January 5, 2006. The updated information was verified by the guideline developer on January 19, 2006. The guideline developer agreed to not review the content. This NGC summary was updated by ECRI Institute on May 18, 2010. The guideline developer agreed to not review the content. This summary was updated by ECRI Institute on January 13, 2011 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents. This summary was updated by ECRI Institute on April 17, 2013. The guideline developer agreed to not review the content. This summary was updated by ECRI Institute on February 15, 2017 following the U.S. Food and Drug Administration advisory on general anesthetic and sedation drugs. This NGC summary was updated by ECRI Institute on June 7, 2018. The guideline developer agreed to not review the content.

This NEATS assessment was completed by ECRI Institute on May 16, 2018. The information was verified by the guideline developer on June 7, 2018.

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